

Exponential functions

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Introduction


▶ $y = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$

▶ $y = x^2$

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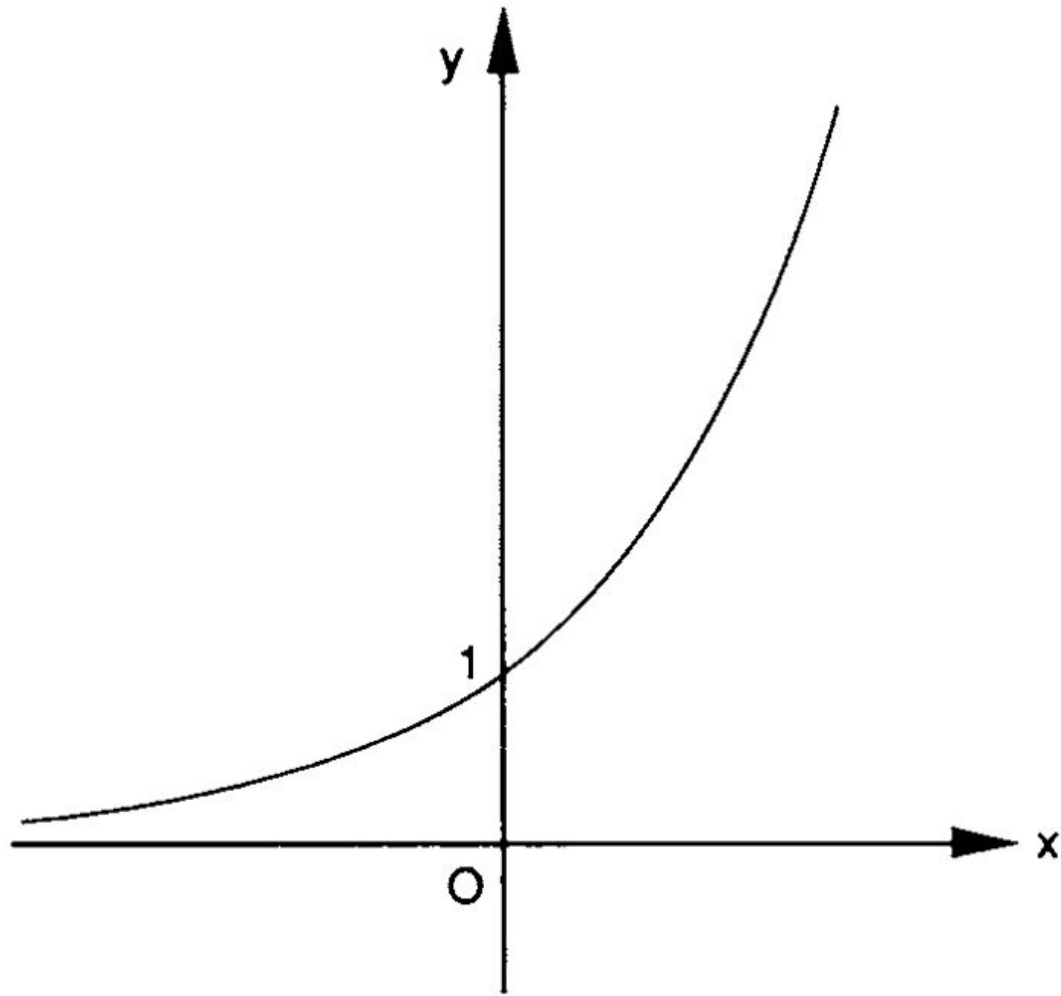


Introduction

$$y = x^2 \xrightarrow{\text{green arrow}} y = 2^x \xrightarrow{\text{green arrow}} y = b^x$$

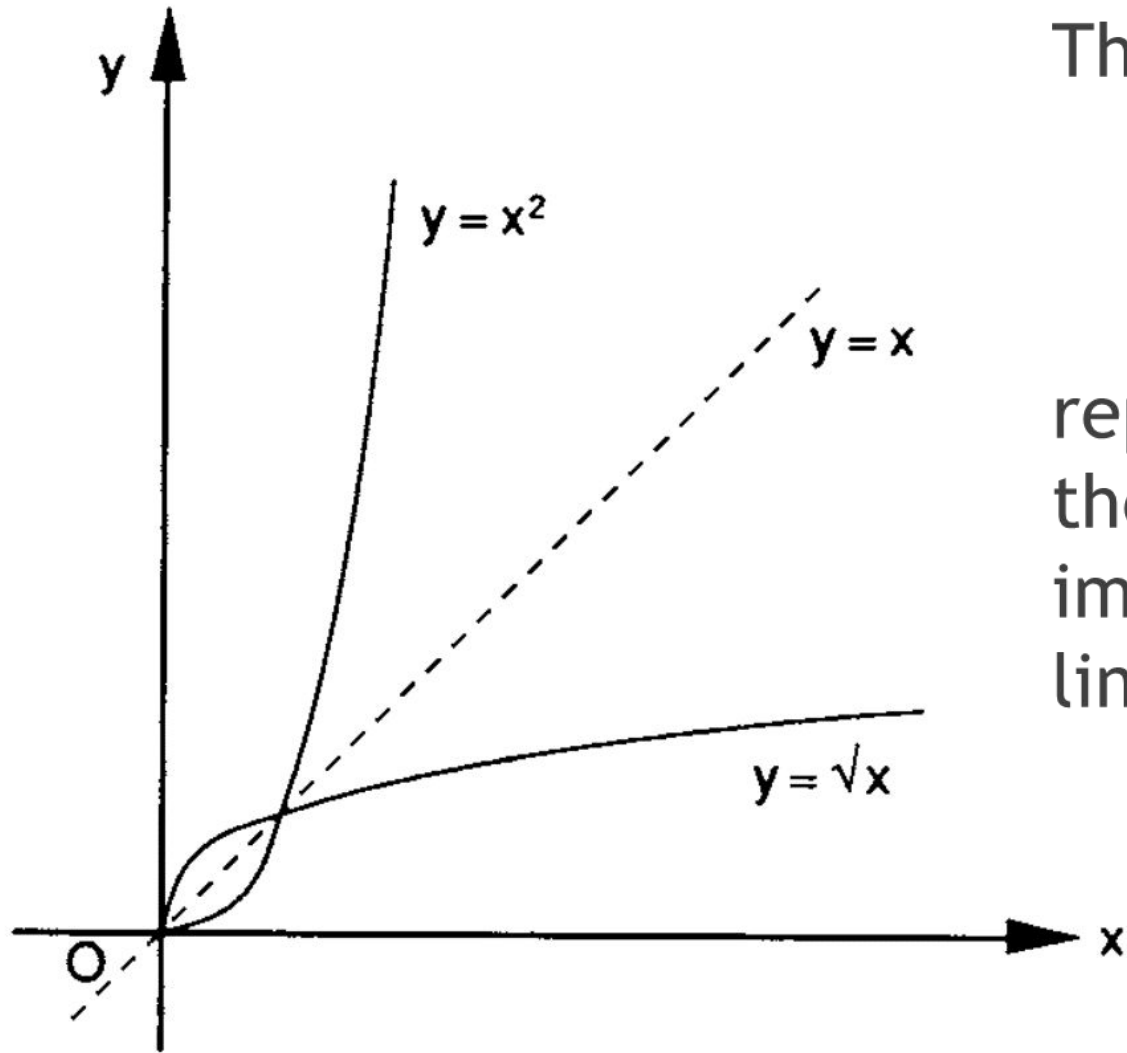
u^v was introduced by Leibniz in
1695

Graph of the exponential function



$$y = b^x$$

Inverse functions



The equations

$$y = x^2$$

and

$$y = \sqrt{x}$$

represent inverse functions;
their graphs are mirror
images of each other in the
line $y = x$.

Inverse functions

▶

$$y = b^x$$

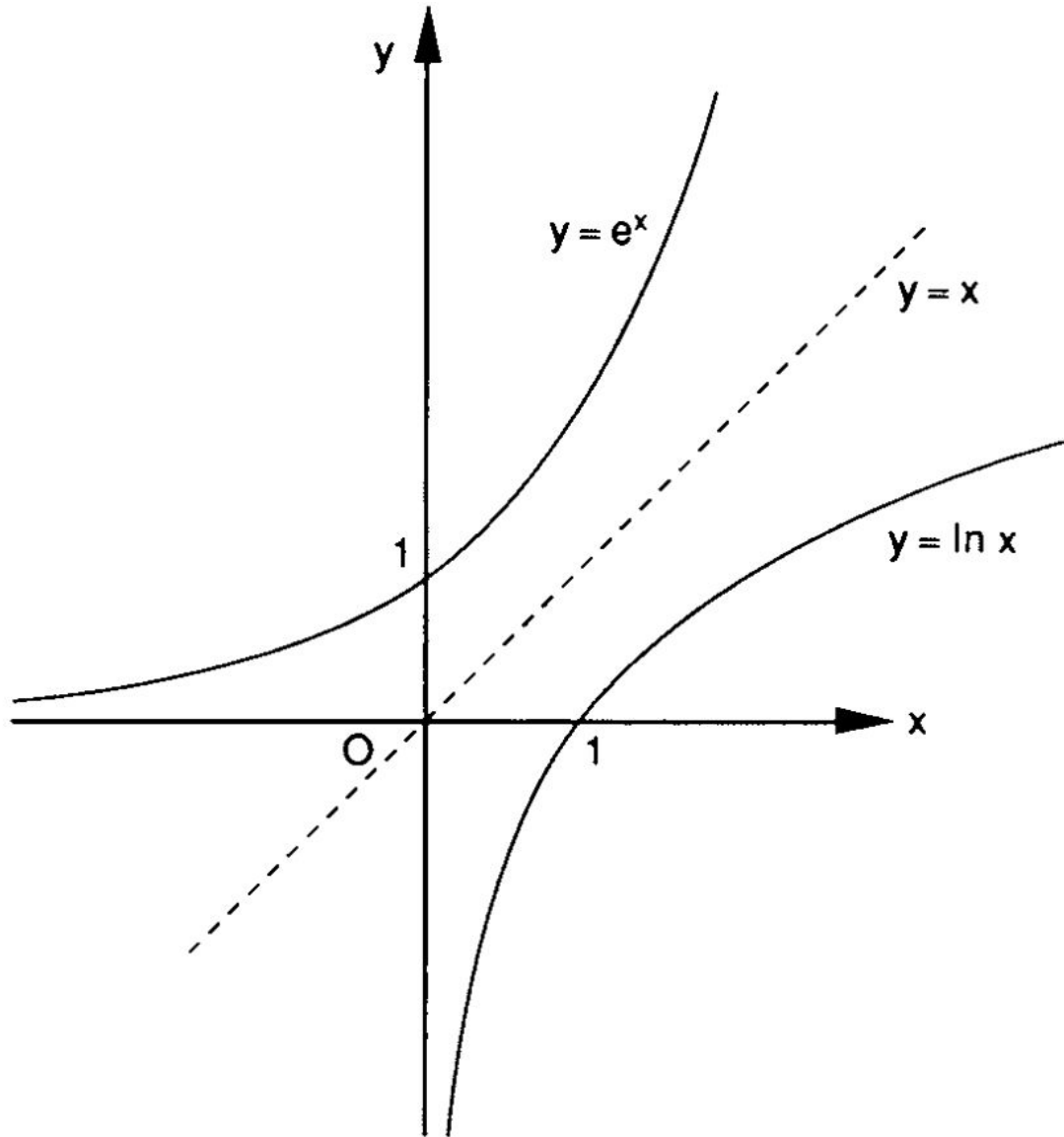


$$x = \log_b y$$

$$y = \log_b x$$

(or $y = \ln x$ if $b = e$)

Inverse functions



The equations

$$y = e^x$$

and

$$y = \ln x$$

represent inverse functions.

Derivative of an exponential function

1. $\frac{dy}{dx} = \lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x}, y = b^x$

2. $\Delta y = b^{x+\Delta x} - b^x = b^x b^{\Delta x} - b^x = b^x (b^{\Delta x} - 1)$

3. $\frac{dy}{dx} = \lim_{\Delta x \rightarrow 0} \frac{b^x (b^{\Delta x} - 1)}{\Delta x} \longrightarrow \frac{dy}{dx} = b^x \lim_{\Delta x \rightarrow 0} \frac{(b^{\Delta x} - 1)}{\Delta x}$

If $k = \lim_{\Delta x \rightarrow 0} \frac{(b^{\Delta x} - 1)}{\Delta x}$, then $\frac{dy}{dx} = kb^x = ky$

The end



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